WHAT IS CLAIMED IS:

1. A fluid coupler comprising a female coupler 1 and a male coupler, wherein

said female coupler 1 comprises:

a cylindrical coupler body, having an axis, a front end directed towards said male coupler, a rear end directed away from said male coupler, and interior and exterior surfaces extending between said front and rear ends;

a stationary valve member provided inside and securely connected to said cylindrical coupler body, said stationary valve member having a head positioned at or adjacent said front end of said cylindrical coupler body and a first sealing ring provided on an outer peripheral surface of said head, and,

a cylindrical movable valve member having an axis in parallel with said axis of said cylindrical coupler body, a front end, a rear end, a front end portion extending from said front end towards said rear end, and exterior and interior surfaces extending between said front and rear ends, said cylindrical movable valve member being positioned between said cylindrical coupler body and said stationary valve member and axially movable between:

a closing position wherein said interior surface of said front end portion thereof covers and sealingly engage said first sealing ring of said head, and

an opening position wherein said cylindrical movable valve member has been moved rearwards relative to said stationary valve member and separated from said head,

said male coupler comprises:

a cylindrical coupler body, having an axis, a front end directed towards said female coupler, a rear end directed away from said female coupler, a front end portion extending from said front end towards said rear end, and exterior and interior surfaces extending between said front and rear ends;

a secondary movable valve member inside said cylindrical coupler body and having a front end, a rear end, a front portion extending from said front end towards said rear end, and an exterior surface;

a cylindrical primary movable valve member having an axis in parallel with said axis of said cylindrical coupler body, a front end, a rear end, a front portion extending from said front end towards said rear end, and exterior and interior surfaces, said cylindrical primary movable valve member being positioned between said secondary movable valve member and said cylindrical coupler body, of said male coupler, said exterior surface of said cylindrical primary movable valve member cooperating with said interior surface of said cylindrical coupler body to define a fluid passage of said male coupler; and,

a second sealing ring provided on said interior surface of said front end portion of said cylindrical coupler body of said male coupler;

said secondary movable valve member being movable between:

a forward position at a time when said male coupler has not been inserted into said female coupler, wherein said front end thereof is positioned at or adjacent to said front end of said cylindrical coupler body and

a rearward position at a time when said male coupler has

been inserted into said female coupler to establish a fluid connection between said female and male couplers,

said primary movable valve member being movable between:

a forward closing position at the time when said male coupler has not been inserted into said female coupler, wherein said front end portion of said primary movable valve member is positioned between said front end portion of said cylindrical coupler body, having said second sealing ring and said front end portion of said secondary movable valve member and sealingly engaged with said second sealing ring; and,

a rearward opening position at the time when the male coupler has been inserted into said female coupler to establish said fluid connection between said female and male couplers, wherein said front end portion of said primary movable valve member is separated rearwards from said front end portion of said cylindrical coupler body having said second sealing ring to define a fluid passage opening between said front end portion of said cylindrical coupler body and said front end portion of said primary movable valve member which opening is fluidly communicated with said fluid passage of said male coupler defined between said interior surface of said cylindrical coupler body and said exterior surface of said primary movable valve member;

wherein

in an initial stage of insertion of the male coupler into said female coupler, said movable and stationary valve members, of

said female coupler respectively abut and move said primary and secondary movable valve members, of said male coupler rearwards relative to said cylindrical coupler body of said male coupler;

in a second stage of said insertion, said stationary valve member of said female coupler further moves said secondary movable valve member rearwards relative to said primary movable valve member so that the front end portion of said stationary valve member advances into said front end portion of said primary movable valve member and, thus, the interior surface of said front end portion of said primary movable valve member covers and sealingly engages said first sealing ring and, simultaneously, said front end portion of said cylindrical coupler body, of said male coupler overlaps said exterior surface of said front end portion of said movable valve member of said female coupler so that said second sealing ring is covered and sealingly engaged by said exterior surface of said movable valve member; and,

in a final stage of said insertion, said movable valve member of said female coupler is moved rearwards by said cylindrical coupler body, of said male coupler to said opening position with said second sealing ring being kept engaged by said exterior surface of said movable valve member, and said primary movable member of said male coupler is moved rearwards by said stationary valve member together with said secondary valve member to said rearward opening position while keeping said first sealing ring sealingly engaged by said interior surface of said front end portion of said primary movable valve member.

2. A fluid coupler as set forth in claim 1 wherein

said secondary movable valve member is, in said final stage, engaged with said primary movable valve member and, then, moved rearwards by said stationary valve member together with said primary movable valve member.

3. A fluid coupler as set forth in claim 2 further comprising:

a first spring urging said cylindrical movable valve members of said female coupler to said closing position;

a second spring urging said primary movable valve member of said male coupler to said forward closing position; and,

a third spring provided between said primary movable valve member and said secondary movable valve member so as to urge said secondary movable valve member to said forward position;

wherein spring constants of said first, second and third springs are set as:

first spring>second spring>third spring.

4. A fluid coupler as set forth in claim 2 wherein

said female coupler further comprises:

a locking ball held by said cylindrical coupler body of said female coupler in such a manner that the locking ball is movable between a locking position wherein said locking ball partly projects radially inwardly from the interior surface of said cylindrical coupler body and a non-locking position wherein said locking ball is retracted radially outwardly from said locking position; and,

a locking ball support member positioned between said cylindrical coupler body and said cylindrical movable valve member of said female coupler and having a cylindrical body slidably engaged with said interior surface of said cylindrical coupler body, and an annular end wall provided at

a front end of said cylindrical body and extending between said interior surface of said cylindrical coupler body, and said exterior surface of said front portion of said cylindrical movable valve member of said female coupler,

wherein said exterior surface of said cylindrical movable valve member of said female coupler has a small diameter front portion extending rearwards from said front end of the movable valve member, a large diameter portion and an intermediate portion connecting said small diameter front portion and said large diameter portion, the intermediate portion being engaged by said annular end wall of said locking ball support member which has been moved rearwards by said front end of said cylindrical coupler body of said male coupler in said second stage of said insertion of said male coupler into said female coupler; and,

said front end portion of said cylindrical coupler body, of said male coupler is sized to be inserted into an annular space formed between said interior surface of said cylindrical coupler body of said female coupler and said small diameter front end portion of said exterior surface of said movable valve member and is provided on its exterior surface with an annular recess which receives said locking ball at the time when said male coupler has been inserted into said female coupler to fluidly connect the female and male couplers.

5. A fluid coupler as set forth in claim 4 wherein

said interior surface of said front end portion of said cylindrical coupler body, of said male coupler is provided with an annular groove for receiving said second sealing ring, said annular groove comprising a small diameter annular portion and a large diameter annular portion which is closer to said front end of said cylindrical coupler body, of said male coupler than said small diameter portion and connected to said small diameter

portion;

said second sealing ring has a Y-shaped cross-section comprising a base portion and a bifurcated portion wherein the base portion is directed towards said front end of said cylindrical coupler body, of said male coupler and said bifurcated portion directed away from said front end, said second sealing ring being disposed in said annular groove in such a manner that said base portion is positioned in said large diameter portion and said bifurcated portion is positioned in said small diameter portion; and,

said male coupler further comprises an annular rigid ring disposed in said large diameter portion of said annular groove in such a manner that the annular rigid ring urges said base portion of said second sealing ring radially outwardly to securely hold said second sealing ring in said annular groove.